(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 277 465 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 87830457.5

(51) Int. Cl.4: **B60T 15/24**

(22) Date of filing: **22.12.87**

(30) Priority: **30.12.86 IT 6799586**

(43) Date of publication of application:
10.08.88 Bulletin 88/32

(84) Designated Contracting States:
AT BE CH DE ES FR GB IT LI NL SE

(71) Applicant: **INDUSTRIE MAGNETI MARELLI S.r.l.**
Via Adriano 81
I-20128 Milano(IT)

(72) Inventor: **Angelillo, Domenico**
Via Pisa 54
I-20099 Sesto San Giovanni Milano(IT)

(74) Representative: **Quinterno, Giuseppe et al**
c/o Jacobacci-Casetta & Perani S.p.A. Via Alfieri, 17
I-10121 Torino(IT)

(54) Servo-distributor for a pneumatic braking system of a tractor, for controlling the braking of a trailer towed by the tractor.

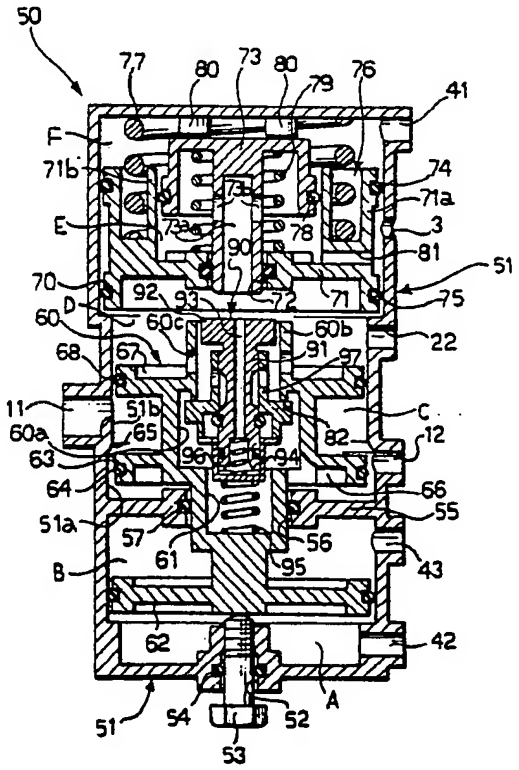
(57) The servo-distributor is intended to be installed in the braking system of a tractor, including a distributor activated by the brake pedal to control braking.

The servo-distributor comprises a hollow body (51) in which is provided a relay valve (92, 73a; 82, 97) controlled by the pressures in a control chamber (F, A) in such a way that, during braking, the relay valve (92, 73a; 82, 97) disconnects an outlet chamber (D) from an exhaust chamber (E) and connects a supply chamber (C) to the outlet chamber (D).

Valve means (63, 64; 51b) operatively associated with the relay valve (73a, 92; 82, 97) are also provided in the supply chamber (C) and, during service braking, are intended to assume a first condition in which they allow communication between the supply connector (11) and the outlet connector (12) when the difference between the pressure in the control chamber (A; F) and the pressure in the outlet chamber (D) is less than a predetermined value, and a second condition in which they disconnect the outlet connector (12) from the supply connector (11) when the difference in pressure exceeds a predetermined value.

By virtue of these characteristics, the servo-distributor also carries out the functions which, according to prior art, were performed by a supplementary so-called servo-diverter device.

FIG. 2



EP 0 277 465 A1

Servo-distributor for a pneumatic braking system of a tractor, for controlling the braking of a trailer towed by the tractor.

The present invention relates to a servo-distributor for a pneumatic braking system for a tractor, intended to control the braking of a trailer towed by the tractor, the braking system including a braking control distributor controlled by the brake pedal.

The invention relates in particular to a servo-distributor comprising a hollow body in which are defined

a supply chamber intended to be connected to a pressure source through a supply connector, and to a line for supplying pressure to the braking system of the trailer through an outlet connector;

an exhaust chamber communicating with the atmosphere through an exhaust opening;

at least one first control chamber intended to be connected to a corresponding outlet of the distributor through an inlet connector;

an outlet chamber intended to be connected to a line for supplying the braking control pressure to the braking system of the trailer;

there being provided in the body relay valve means controlled by the pressure in the control chamber in such a way that, during braking, the valve means disconnect the outlet chamber from the exhaust chamber and connect the supply chamber to the outlet chamber.

A known device of this type consists, for example, of a triple-control servo-distributor marketed by the Applicants with the designation AC590.

During service braking, this device sends braking control pressure to the control line (known as the "regulable" line) of the braking system of the trailer with a certain advance, known as predominance, relative to the application of the service braking of the tractor. This advance ensures the pull of the trailer during braking.

In such braking systems for tractors, a servo-diverter device, which allows the braking of the trailer to be activated even in the event of damage to the regulable line, is connected to the triple-control servo-distributor. A unit comprising a triple-control servo-distributor and a servo-diverter is constituted, for example, by the device produced and marketed by the Applicants with the designation AC 595. Another triple-control servo-distributor provided with a servo-diverter is known, for example, from the manual "Geräte für Druckluftbremsanlagen", first edition, May 1982, pp. 42, 43 published by Robert Bosch GmbH.

In these known devices, the servo-diverter consists of equipment which is physically separate from the triple-control servo-distributor and is connected to it externally by means of suitable connectors.

The object of the present invention is to produce a servo-distributor of the type specified above, modified in such a way that it is itself able to carry out the functions of the servo-diverter and does not therefore require the use of suitable separate equipment to perform these functions.

According to the invention, this object is achieved by means of a servo-distributor of the type specified above, the main characteristic of which lies in the fact that valve means operatively associated with the relay valve means are also provided in the supply chamber and, during service braking, are intended to assume a first condition in which they allow communication between the supply connector and the outlet connector when the difference between the pressure in the control chamber and the pressure in the outlet chamber is less than a predetermined value, and a second condition in which they disconnect the outlet connector from the supply connector when the difference between the pressure in the control chamber and the pressure in the outlet chamber exceeds a predetermined value.

In the servo-distributor according to the present invention, in event of rupture of the regulable line of the trailer during service braking, the pressure in the outlet chamber is discharged through the point of rupture; the pressure supply line to the reservoirs of the trailer ("automatic line") is disconnected from the pressure source of the tractor and put into communication with the atmosphere through the relay valve means, the outlet chamber and the point of rupture of the regulable line. Thus, activation of the brakes of the trailer occurs automatically.

Further characteristics and advantages of the servo-distributor according to the present invention will become clear from the detailed description which follows with reference to the appended drawings, provided purely by way of non-limiting example, in which:

Figure 1 shows a triple-control servo-distributor according to the present invention,

Figure 2 is an axial section of the servo-distributor of Figure 1, showing a first operating condition of the device,

Figure 3 is a view similar to Figure 2, showing the servo-distributor in another operating condition,

Figures 4 and 5 are axial sections of a variant of the device according to the invention in first and second operating conditions respectively,

Figures 6 and 7 are sectional views similar to Figures 1 and 2, which show a further variant of the device according to the invention, in first and second operating conditions respectively,

Figure 8 is an axially sectioned view of a further variant of the device according to the invention, and

Figure 9 is a sectional view of another variant of the device according to the invention.

A servo-distributor according to the present invention is generally indicated 50 in Figure 1. This includes a metal body 51 which has a substantially elongate cylindrical shape in the example illustrated. This body is hollow and, in its middle region, has a supply connector 11 for connection to a pressure reservoir of the braking system of a tractor. An outlet connector for connection to the line (automatic line) for supplying pressure to the reservoir of the braking system of a trailer is indicated 12. As can be seen from Figure 2, in the embodiment illustrated, the connectors 11 and 12 are in respective axially staggered positions relative to the longitudinal axis of the body 51.

Further inlet connectors at the ends of the body 51 are indicated 41 and 42.

Between the connectors 12 and 42, the body 51 has a further inlet connector 43, whilst a further outlet connector 22 is formed between the connectors 12 and 41.

An exhaust opening to the atmosphere, indicated 3, is formed in the wall of the body 51 between the connectors 22 and 41.

For ease of reading on the part of persons skilled in the art, the connectors described above have been distinguished with reference numerals corresponding to the marking system according to international standards of identification for the orifices of equipment for braking systems.

As seen in detail in Figures 2 and 3, there is formed in the base wall of the body 51 a partially threaded opening 52 in which is engaged a regulating screw 53 whose shank is correspondingly partially threaded. A sealing ring 54 is situated in the opening 52, around the smooth portion of the shank of the screw 53.

In the axial portion of the body 51 between the connectors 12 and 43, the body has a transverse wall 55 with a central hole 56 in which there is a sealing ring 57.

A movable element, generally indicated 60, has a hollow middle portion 61 axially sealingly slidably mounted in the hole 56 in the wall 55. The portion of this movable element which extends below the wall 55 has a substantially disc-shaped circumferential protrusion 62 sealingly slidably mounted like a piston in the axial portion of the body 51 between the connectors 42 and 43.

The variable-volume chamber defined between the lower portion of the body 51 and the disc portion 62 of the movable element 60, into which the connector 42 opens, is indicated A. The connector 42 is intended to be connected to the outlet of one of the two sections of the duplex or tandem-type distributor (not illustrated) which is activated by the brake pedal to control braking in the two independent circuits of the tractor.

Between the disc portion 62 of the movable element 60 and the wall 55 of the body 51, there is defined a further variable-volume chamber, indicated B, into which the connector 43 opens. This connector is intended to be connected to a manually operated valve or distributor for controlling parking and emergency braking. The chamber B is normally kept under pressure: the pressure in this chamber decreases upon operation of the manual valve or distributor for controlling parking and emergency braking (not illustrated), connected to the connector 43.

Above the transverse wall 55, the body 51 has, firstly, a portion 51a in which a skirt portion 63 of the movable element 60, provided externally with a sealing ring 64, extends with radial clearance. The portion 51a is joined at 65 to a succeeding axial portion 51b of the body 51, coaxial with the former but having a reduced diameter.

The skirt portion 63 of the movable element 60 can slide sealingly like a piston against the wall of the reduced-diameter portion 51b of the body.

The outlet connector 12 is formed in the larger-internal-diameter portion 51a of the body, whilst the connector 11 opens into the reduced-internal-diameter portion 51b.

At least one aperture, indicated 66 in Figures 2 and 3, which establishes communication between the cavity of the movable element and the region above the wall 55, is formed in the skirt portion 63 of the movable element.

A further skirt portion of the movable element 60, indicated 67, is axially spaced from the portion 63 and carries a peripheral sealing ring, indicated 68. The portion 67 of the movable element is sealingly slidable in the portion of the body 51 between the connectors 11 and 22 and, with the wall 55, defines a variable-volume supply chamber C. During operation, the compressed air coming from the reservoir of the tractor braking system through the connector 11 and the chamber C reaches the outlet connector 12 and, through the automatic line, arrives at the pressure reservoir of the trailer braking system.

The diameter of the axial upper end portion of the body 51 above the connector 22 is increased again to form a shoulder, indicated 70. Sealingly slidably mounted in this portion of the body 51 is a piston 71 having a central hole 72 through which a further piston 73 is axially sealingly slidable.

The piston 71 has an external tubular part 71a carrying external sealing rings 74 and 75 in contact with the wall of the body 1, and a radially more internal tubular part 71a coaxial with the former and forming with it an annular housing 76 in which a helical spring 77 extends.

The piston 73 is essentially mushroom-shaped. Its lateral wall carries an external sealing ring 78 and is axiall slidable within the internal tubular part 71b of the piston 71. The piston 73 has a tubular shaft or stem 73a sealingly slidably mounted in the hole 72 in the piston 71. A helical spring 79 is interposed between the head of the piston 73 and the piston 71. This spring biases the piston 73 against the stops 80 on the upper wall of the body 51.

The portion of the head of the piston 71 between its tubular parts 71a and 71b has a radial passage 81 which is permanently in communication with the exhaust opening 3 to atmosphere.

The stem 73a of the piston 73 has apertures 73b in a portion which is always above the hole 72 in the piston 71, whatever the relative position assumed by the piston 73 with respect to the piston 71.

A variable-volume chamber between the portion 67 of the movable element 60 and the piston 71 is indicated D. The outlet connector 22 faces this chamber.

An exhaust chamber between the pistons 71 and 73 is indicated E. This chamber is in permanent communication with the exhaust opening 3 to the atmosphere through the passage 81. This chamber can also communicate with the chamber D through the apertures 73b of the stem 73.

A control chamber between the upper end wall of the body 51 and the pistons 71 and 73 is indicated F. The inlet connector 41 opens into this chamber. In use, this connector is connected to the outlet of the other section of the duplex or tandem distributor of the tractor braking system.

As stated above, the movable element 60 is hollow and its cavity, indicated 60a, opens upwardly towards the chamber D through a tubular part 60b. This tubular part extends towards the piston 71 and has through-holes 60c.

A valve seat formed by an axial extension of the tubular part 60b towards the cavity 60a of the movable element 60 is indicated 82.

A movable element, indicated 90, comprises a core 91 which has a head 92 at the top and in which an axial through-hole 93 is formed. This core has a lower end slidably mounted in a cup element 94 urged upwardly by a spring 95 which reacts against the base wall of the cavity of the element 60. A spring 96 is situated between the base wall of the cup element 94 and the core 91. A tubular element, indicated 97, surrounds the middle portion of the core 91 and bears at its lower end on the upper edge of the cup element 94. The tubular element 97 has a radially enlarged middle portion situated below and facing the valve seat 82 with which it cooperates as an obturator. The valve consisting of the seat 82 and the obturator 97 controls communication between the chambers C and D, which is possible through the passage 66 formed in the skirt portion 63 of the movable element 60.

The head 92 of the core 91 faces the lower end edge of the stem 73a of the piston 73. This end edge of the piston 73 and the head of the core 91 can cooperate like a valve obturator and seat to control communication between the chamber D and the chamber E.

The servo-distributor described above operates in the following manner.

In Figure 2, the servo-distributor is illustrated in the rest condition assumed during normal running of the tractor. In this situation, the connector 43 is continuously supplied with air coming from the manually-controlled valve or distributor for the parking and emergency brakes; this pressure acts on the portion 62 of the movable element 60 to hold this element down against the adjustment screw 53. The compressed air arriving through the inlet connector 11 enters the chamber C and reaches the trailer reservoir through the outlet connector 12 and the automatic line. The obturator 97 is in contact with the seat 82, whilst the obturator 92 is spaced from the end of the piston 73. Consequently, the chamber D is not in communication with the chamber C, but is in communication with the exhaust chamber E and thus with the atmosphere through the passage 81 and the exhaust opening 3. No pressure is therefore supplied to the regulable control line for braking the trailer.

If the brake pedal of the tractor is now operated, the duplex or tandem distributor activated by the brake pedal causes a simultaneous supply of pressure to the chambers F and A through the connectors 41 and 42 of the servo-distributor. The pressure in the chamber F causes the piston 73 to descend, whilst the pressure in the chamber A causes the movable element 60 to rise. When the core 91 abuts the lower end of the piston 73, the chamber D is disconnected from the exhaust chamber E. Further upward displacement of the movable element 60 causes the seat 82 to move away from the obturator 97 and thus puts the chamber D into communication with the supply chamber C. The compressed air present in the chamber C causes braking of the trailer through the chamber D and the regulable braking control line connected to the connector 22.

During service braking, the movable element 60 moves upwardly, as stated, but not far enough,

however, to bring the skirt portion 63 into engagement with the reduced-internal-diameter portion 51b of the body 51.

If, during a service braking phase, the regulable braking control line of trailer connected to the connector 22 ruptures, the chamber D becomes depressurised. The movable element 60 therefore moves further up to bring its portion 63 into engagement with the reduced-diameter portion 51b of the body 51, as shown in Figure 3. In this condition, the supply chamber C is subdivided into two spaces, indicated C_1 and C_2 in Figure 3, which are not in communication with each other. The space 51 is between the portions 63 and 67 of the movable element and communicates with the supply connector 11. The space C_2 is between the portion 63 of the movable element 60 and the internal transverse wall 55 of the body of the servo-distributor and communicates with the connector 12. In the condition illustrated in Figure 3, the space C_2 communicates with the chamber D through the passage 66 and the open valve 82-87 and, hence, through the connector 22, this space communicates with the atmosphere through the point of rupture of the rgulable line. The automatic line therefore discharges into the atmosphere through the connector 12, the space C_2, the chamber D, the connector 22 and the point of rupture of the regulable line. This causes, in known manner, the intervention of the automatic braking of the trailer.

The portion 63 of the movable element 60 with the sealing ring 64, however, cuts off the supply of pressure.

With reference again to Figure 2, if the parking and emergency brakes of the tractor are applied during normal running, the pressure in the chamber B, which tends to keep the movable element 60 down, is lost in known manner. This element therefore ascends until the obturator 97 has left the seat 82 and the chamber C is put into communication with the chamber D. In this case, the servo-distributor also supplies braking control pressure through the regulable line connected to the connector 22, causing braking of the trailer.

Figures 4 and 5 illustrate a first variant of the servo-distributor described with reference to Figures 1 and 3. In Figures 4 and 5, the parts already described above have again been given the same reference numerals.

With respect to the embodiment of Figures 1 to 3, the servo-distributor of Figures 4 and 5 has the following variations.

In the portion adjacent the shoulder 70, the wall of the body 51 has an internal annular groove 51d. This groove communicates with the connector 22 through a slot 99 formed in the shoulder 70.

The width of the annular groove 51d in the body 51 is such that, when the piston 71 strikes the shoulder 70 (Figure 5), a passage 100 communicating with the exhaust opening 3 is defined between the piston and the wall of the body 51.

Between the piston 71 and the portion 67 of the movable element 60 in the chamber D, there is a helical spring 101 which has the function of returning the piston 71 to the rest position of Figure 4.

The servo-distributor of Figures 4 and 5 functions in exactly the same way as the servo-distributor of Figures 1 to 3, both during service braking and during parking and emergency braking. In the event of rupture of the regulable line during service braking, the servo-distributor according to Figures 4 and 5 allows the automatic line to discharge not only through the point of rupture of the regulable line, as occurs in the servo-distributor of Figures 1 to 3, but also directly to the atmosphere through the slot 99 and the passage 100, as shown in Figure 5.

In Figures 6 and 7 a further variant of the servo-distributor according to the invention is shown, which also allows the automatic line to discharge not only through the point of rupture of the regulable line, but also by a direct route to the atmosphere.

The variant of Figures 6 and 7 has the following differences with respect to the servo-distributor of Figures 1 to 3.

Between the inlet connector 43 and the transverse wall 55, the body 51 has a further transverse wall 155 having a central opening 156 provided with a sealing ring 157. This opening is coaxial with the opening in the wall 55 and the axial portion of the movable element 60 between the skirt portion 63 and the lower disc portion 62 is sealingly slidable through it.

Between the transverse walls 55 and 155 there is defined an exhaust chamber E' which communicates with the atmosphere through an exhaust opening 103.

In Figure 6, the servo-distributor is illustrated in the rest condition which it assumes in running conditions. In this condition, the movable element 60 lies in its lower position against the adjustment screw 53. An annular groove 110 is formed in the axial portion of this movable element which, in the rest condition, is between the walls 55 and 155.

In the event of rupture of the regulable line during a service braking phase, as shown in Figure 7, the movable element 60 moves upwards and its skirt portion 63 disconnects the inlet connector from the space C_2, whilst the groove 110 is disposed so as to face the edge of the opening 56 in the transverse wall 55 and define, with respect to the latter, an annular space 111 which puts the space C_2 into communication with the supplementary exhaust chamber E'. In this way, the automatic

line can be discharged rapidly through the annular passage 111 and the supplementary exhaust chamber E', causing intervention of the automatic braking of the trailer.

Finally, Figure 8 illustrates a further variant which has the following differences with respect to Figures 1 to 3.

The lower end portion 91a of the core 91 of the movable element 90 has an external sealing ring 91b and is sealingly slidably mounted in a middle axial portion 120 of the cavity of the movable element 60, which is of reduced section. In the portion of the core between the sealing ring 91b and the obturator 97, this core has an external circumferential groove 130.

A helical spring 195 situated between the core 91 and the base wall of the cavity of the movable element 60 pushes this core upwards into a position in which the circumferential groove 130 of the core is above the restriction 120 of the internal cavity of the movable element 60. In this condition, the obturator 97 lies against the valve seat 82.

If a rupture of the regulable line occurs during service braking, the movable element 60 moves upwards in this case also, and its skirt portion 63 engages the reduced-section portion 51b of the body 51 to disconnect the connector 11 from the connector 12. Moreover, as a result of the upward displacement of the movable element 60, the lower edge of the reduced-section portion 120 of the cavity of this element rises above the lower edge of the circumferential groove 130 of the core 91. Thus, there is no longer a seal between the core and the reduced-section portion 120 of the passage of the element 60. A discharge route is thus created between the space C_2 and the atmosphere through the passage 66, the passage defined between the groove 130 of the core 91 and the base portion of the cavity of the element 60, the axial passage 93 of the core 91, the tubular stem 73a of the piston 73, the exhaust chamber E, the passage 81, and the exhaust opening 3.

In the variant of Figure 8, therefore, the servo-distributor according to the invention also allows rapid discharge of the automatic line in the event of rupture of the regulable line, not only through the point of rupture of the regulable line, but also through the discharge route defined above.

Further variants of the embodiments illustrated in Figures 1 to 5 can be obtained by reversing the roles of the connectors 11 and 12, to close the passage 66 of the movable element 60 and open a new passage 166 between the portions 63 and 67 of this element, as illustrated in Figure 9 (a variant achieved from the mode of realisation of Figures 2-3).

Furthermore, in all the above variants, the portion 63 of the movable element 60 can be provided with a lipped sealing ring, such as that indicated 164 in Figure 9, instead of the sealing ring 64.

Claims

1. A servo-distributor for a pneumatic braking system for a tractor, intended to control the braking of a trailer, the braking system including a distributor for controlling the braking of the tractor, the servo-distributor comprising a hollow body (51) in which are defined

a supply chamber (C) intended to be connected to a pressure source through a supply connector (11) of the body (51), and to a line for supplying pressure to the braking system of the trailer through an outlet connector (12);

an exhaust chamber (E) communicating with the atmosphere through an exhaust opening (3);

at least one control chamber (F,A) intended to be connected to a corresponding outlet of the distributor through an inlet connector (41, 42), and

an outlet chamber (D) intended to be connected to a line for supplying the braking control pressure to the braking system of the trailer,

there being provided in the body (51) relay valve means (92, 73a; 82, 97) controlled by the pressure in the control chamber (F;A) in such a way that, during service braking of the tractor, the relay valve means (73a, 92; 82, 97) disconnect the outlet chamber (D) from the exhaust chamber (E) and connect the supply chamber (C) to the outlet chamber (D);

characterised in that valve means (63, 64; 51b) operatively associated with the relay valve means (73a, 92; 82, 97) are provided in the supply chamber (C) and, during service braking, are intended to assume a first condition in which they allow communication between the supply connector (11) and the outlet connector (12) when the difference between the pressure in the control chamber (A;F) and the pressure in the outlet chamber (D) is lower than a predetermined value, and a second condition in which they disconnect the outlet connector (12) from the supply connector (11) when the difference between the pressure in the control chamber (A;F) and the pressure in the outlet chamber (D) exceeds the predetermined value.

2. A servo-distributor according to Claim 1, characterised in that further valve means (71, 52d; 91, 91b; 120) are provided in the body (51) and are intended to put the outlet chamber (D) into communication with the exhaust opening (3) when the valve means (63, 64; 51b) assume the second condition.

3. A servo-distributor according to Claim 1, characterised in that the body has a supplementary exhaust opening (103) and further valve means (55, 56, 60, 110) intended to put the outlet chamber (D) into communication with the supplementary exhaust opening (103) when the valve means (63, 64, 51b) assume the second condition.

FIG. 1

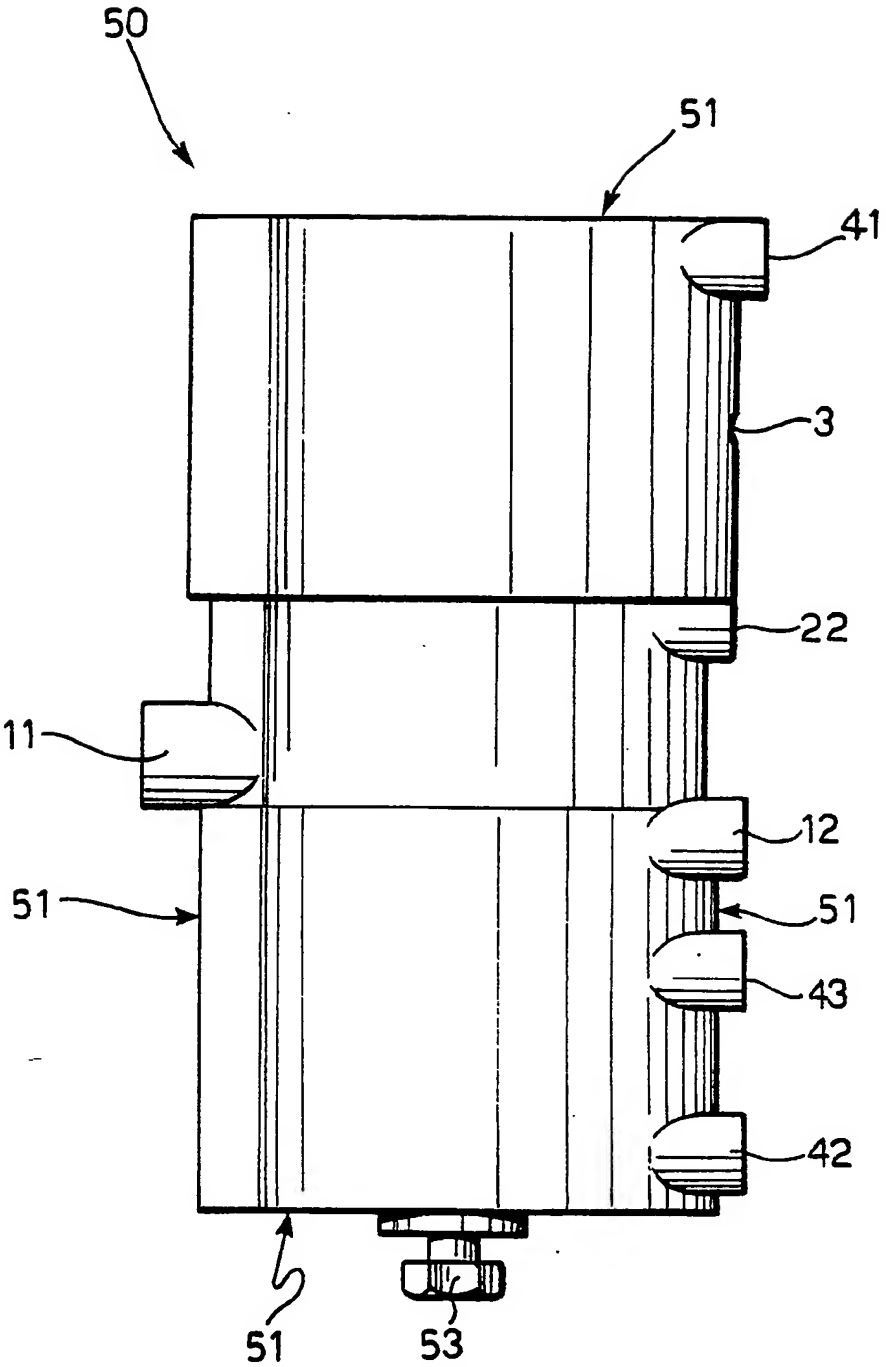


FIG. 2

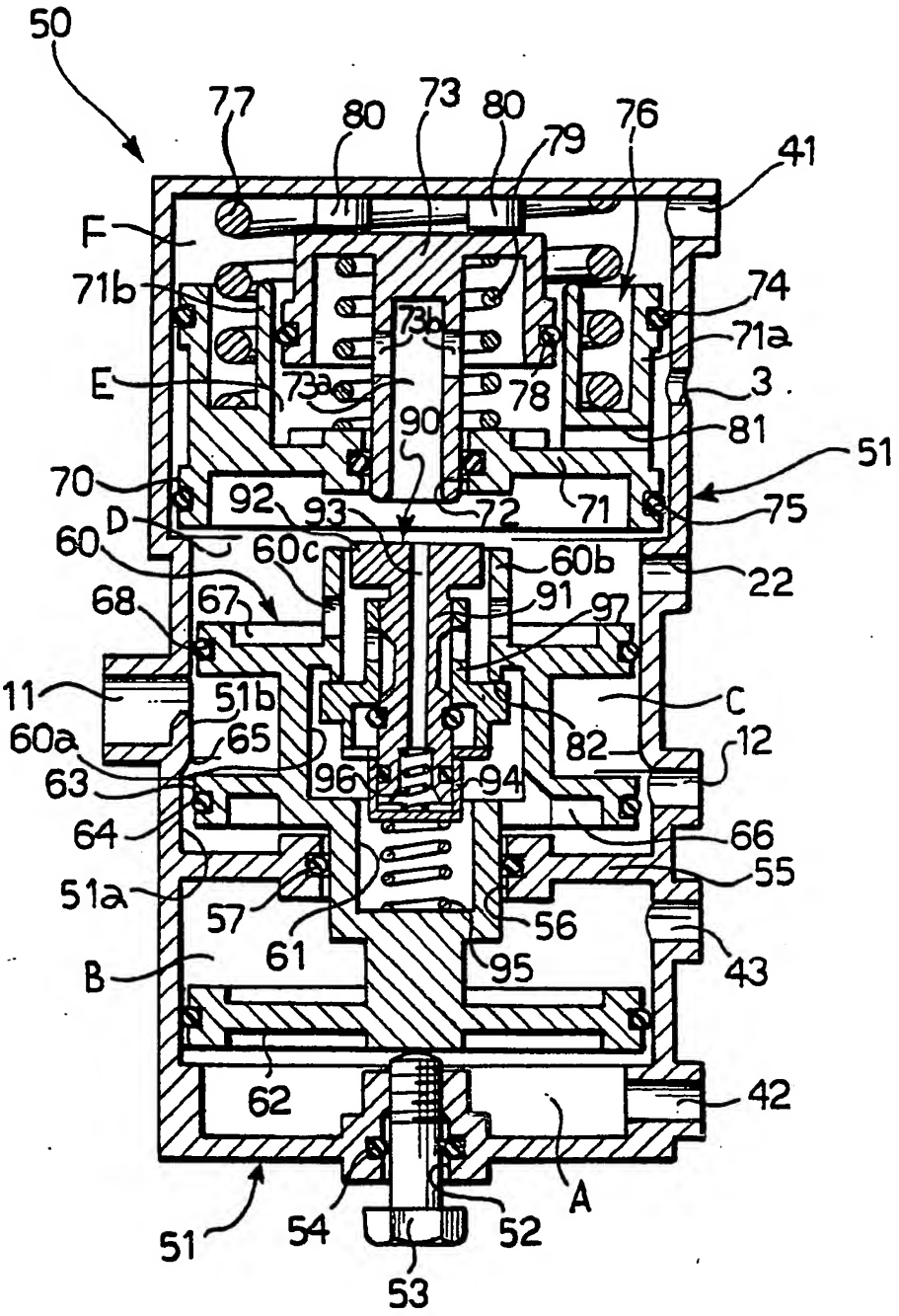

50
77
80
73
80
79
76
41
F
71b
74
73b
71a
E
73a
78
3
90
81
51
70
92
93
72
71
75
D
60
60c
60b
22
68
67
91
97
11
51b
C
60a
65
82
12
63
96
94
64
66
51a
57
56
55
61
95
43
B
62
42
A
51
54
52
53

FIG. 3

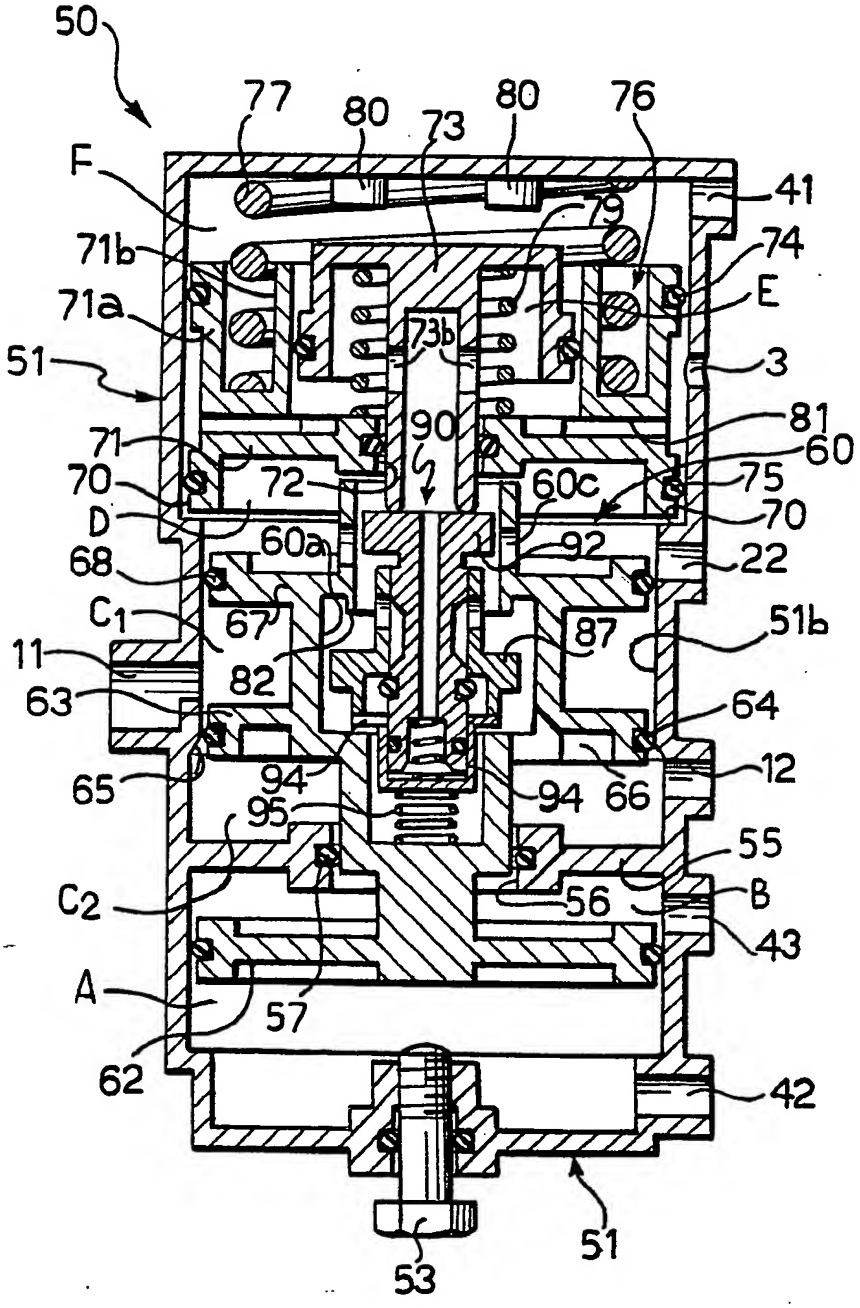

50
77
80
73
80
76
F
41
79
71b
74
71a
E
73b
51
3
90
81
71
60
70
72
60c
75
D
70
60a
92
68
22
C1
67
87
51b
11
82
63
64
94
66
12
65
94
95
55
C2
56
B
43
A
57
62
42
53
51

FIG. 4

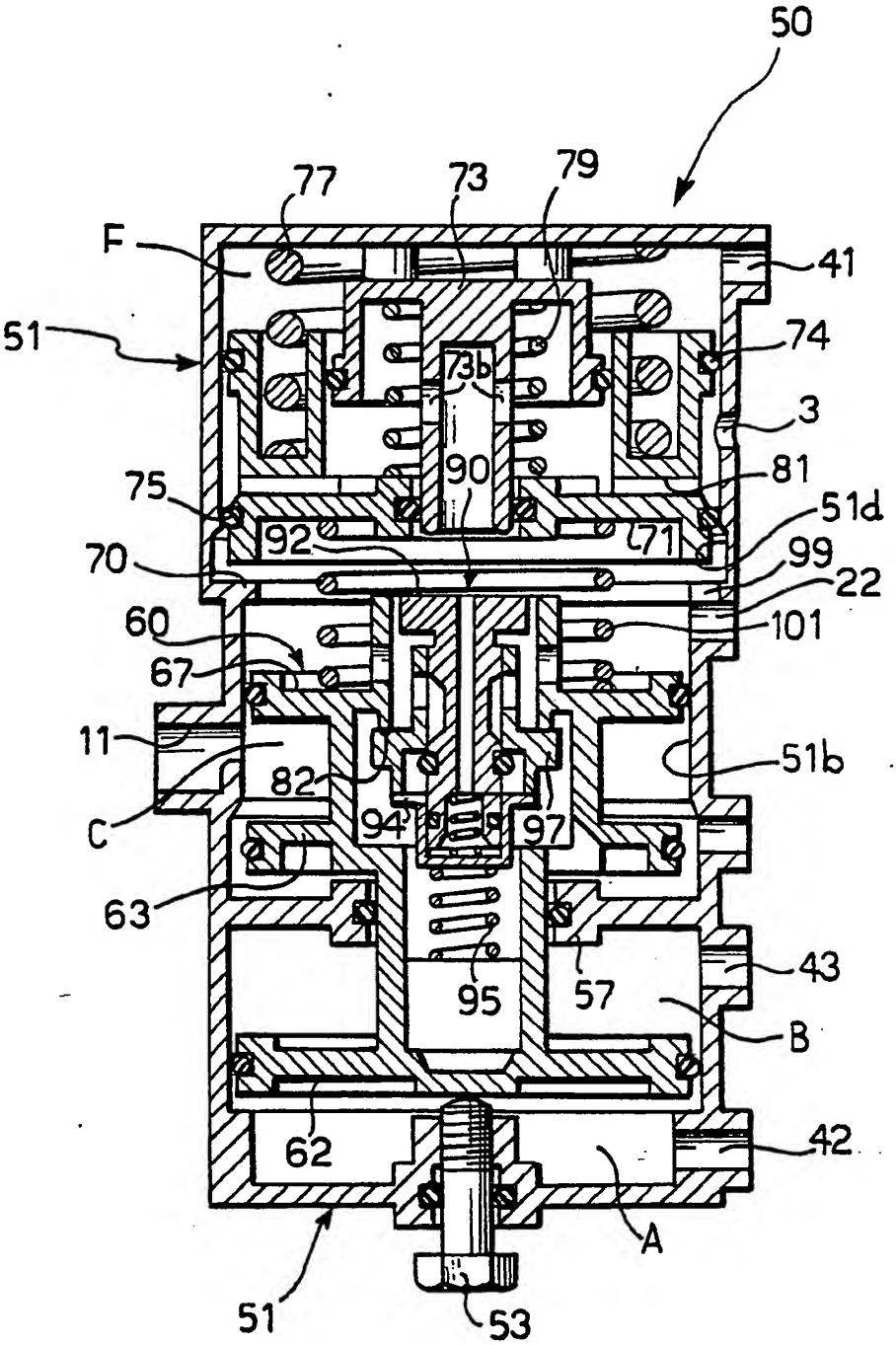

50
77
73
79
F
41
51
74
73b
3
90
81
75
51d
92
71
99
70
22
60
101
67
11
51b
82
C
94
97
63
43
95
57
B
62
42
A
51
53

FIG. 5

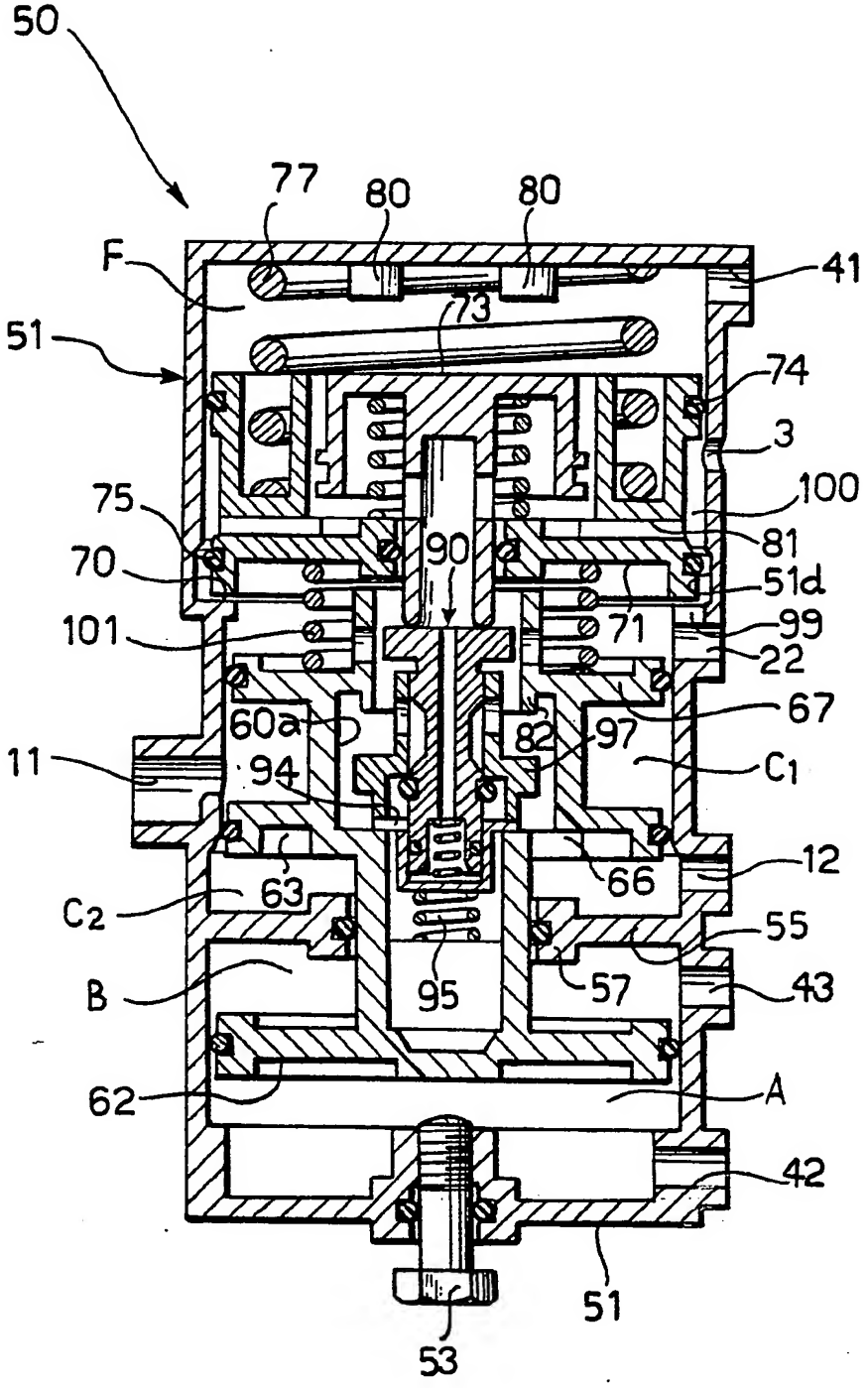

50
77
80
80
F
41
73
51
74
3
100
75
81
90
70
51d
71
99
101
22
67
60a
82
97
11
94
C1
12
63
66
C2
55
B
95
57
43
62
A
42
51
53

FIG. 6

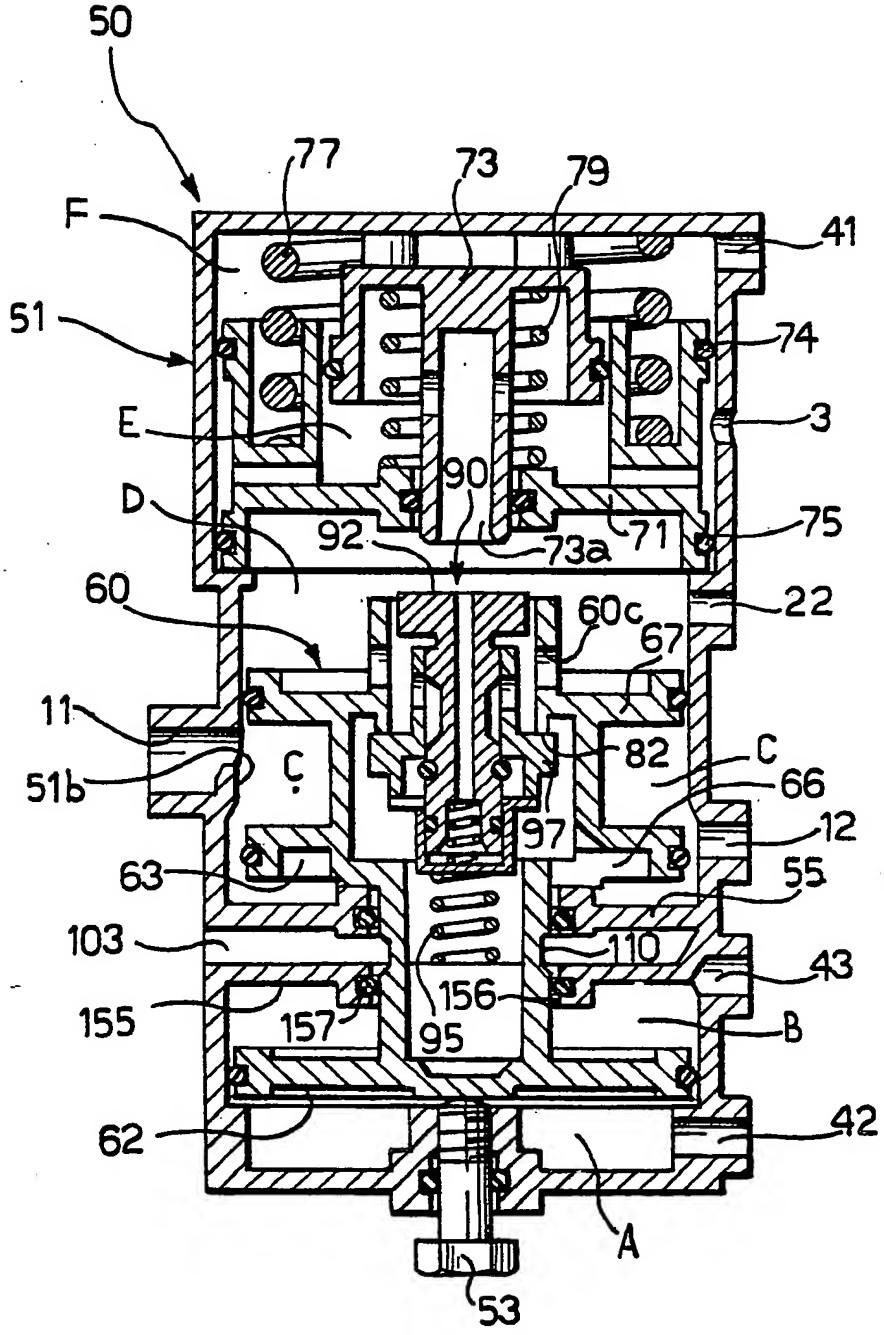

50
77
73
79
F
41
51
74
E
3
90
D
92
73a
71
75
60
60c
22
67
11
82
C
51b
66
97
12
63
55
103
110
43
155
157
156
95
B
62
42
A
53

FIG. 7

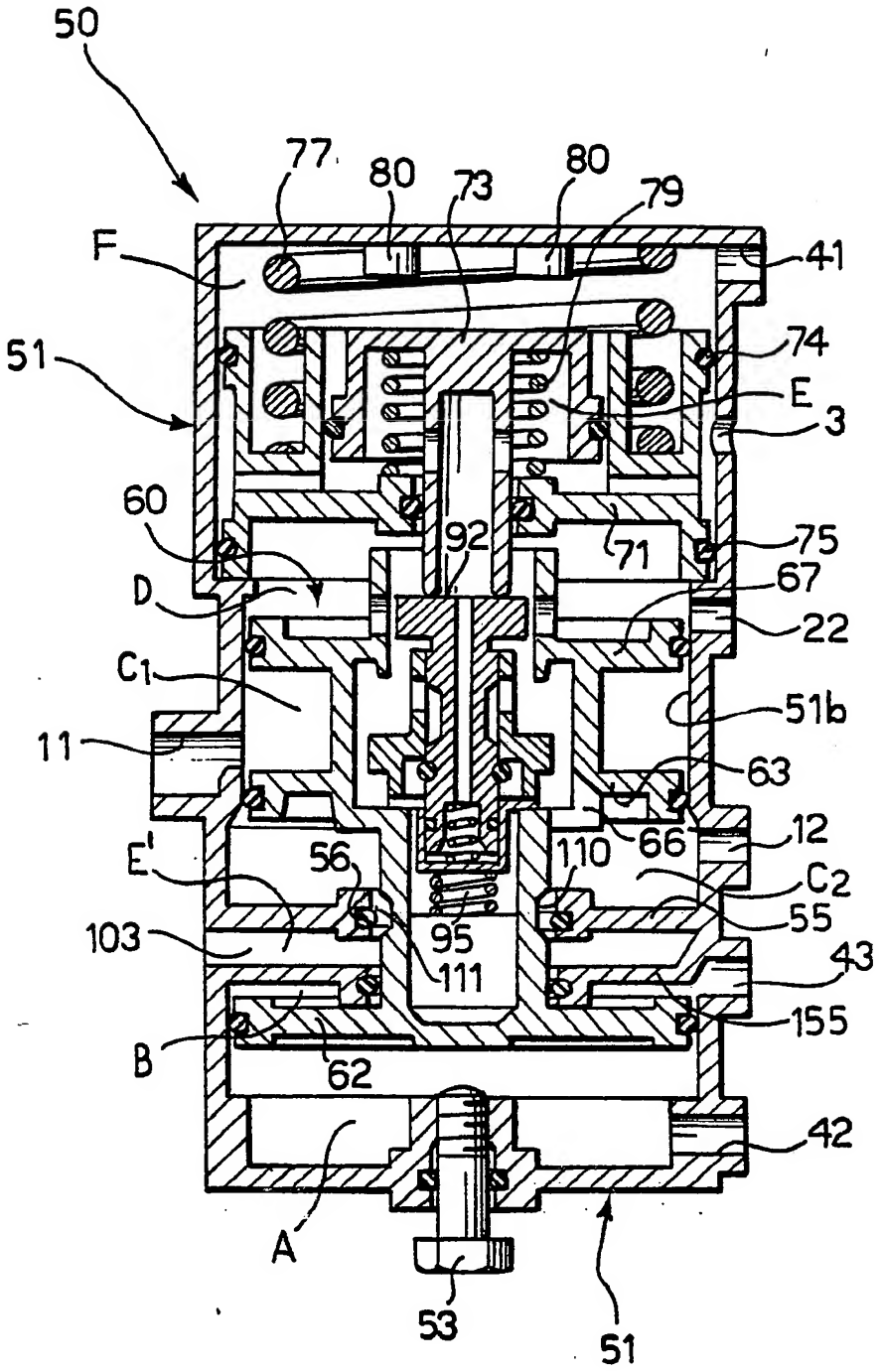

50
77
80
73
80
79
F
41
51
74
E
3
60
92
71
75
D
67
22
C1
51b
11
63
12
E'
56
110
66
C2
55
103
95
111
43
155
B
62
42
A
53
51

FIG. 8

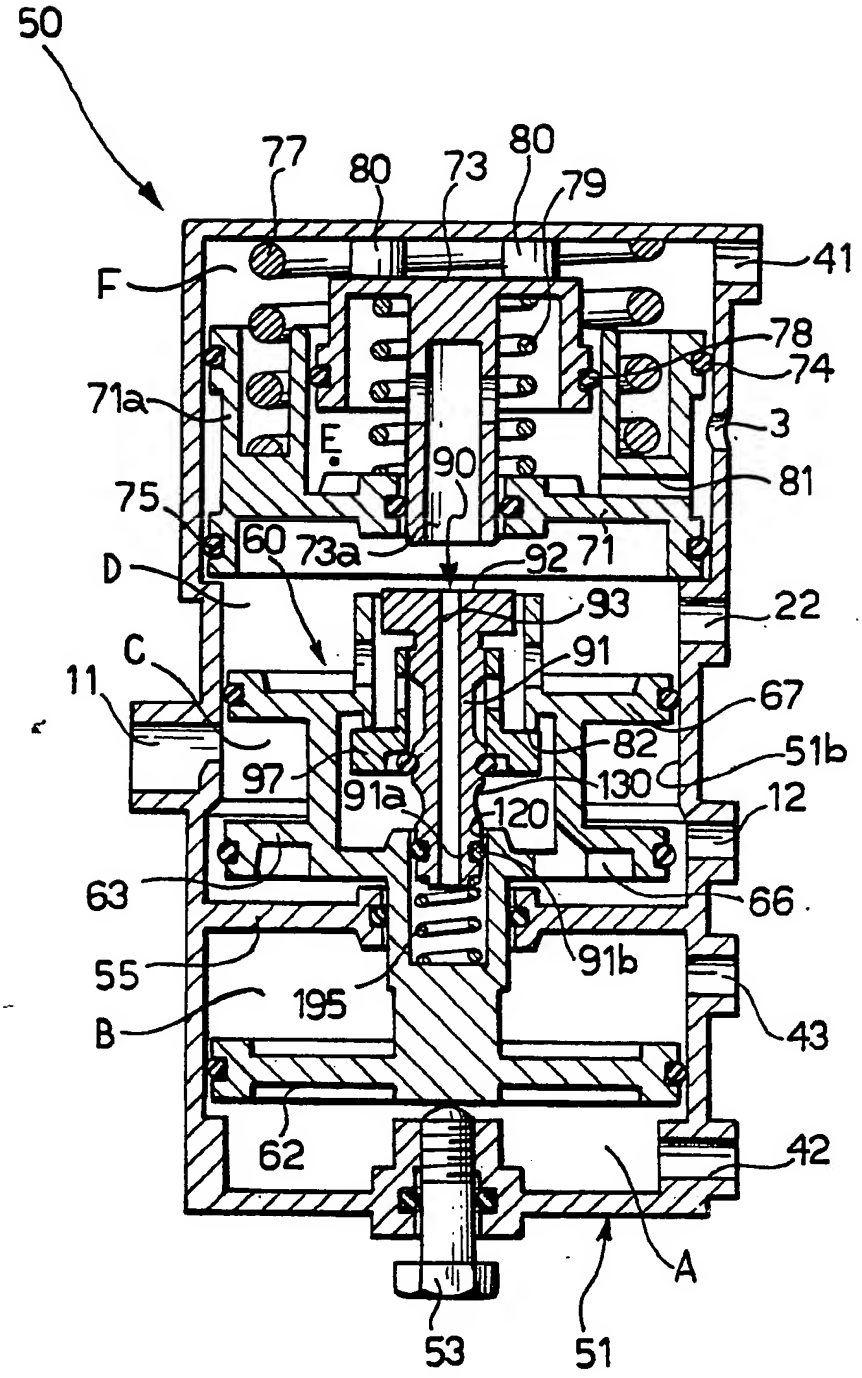
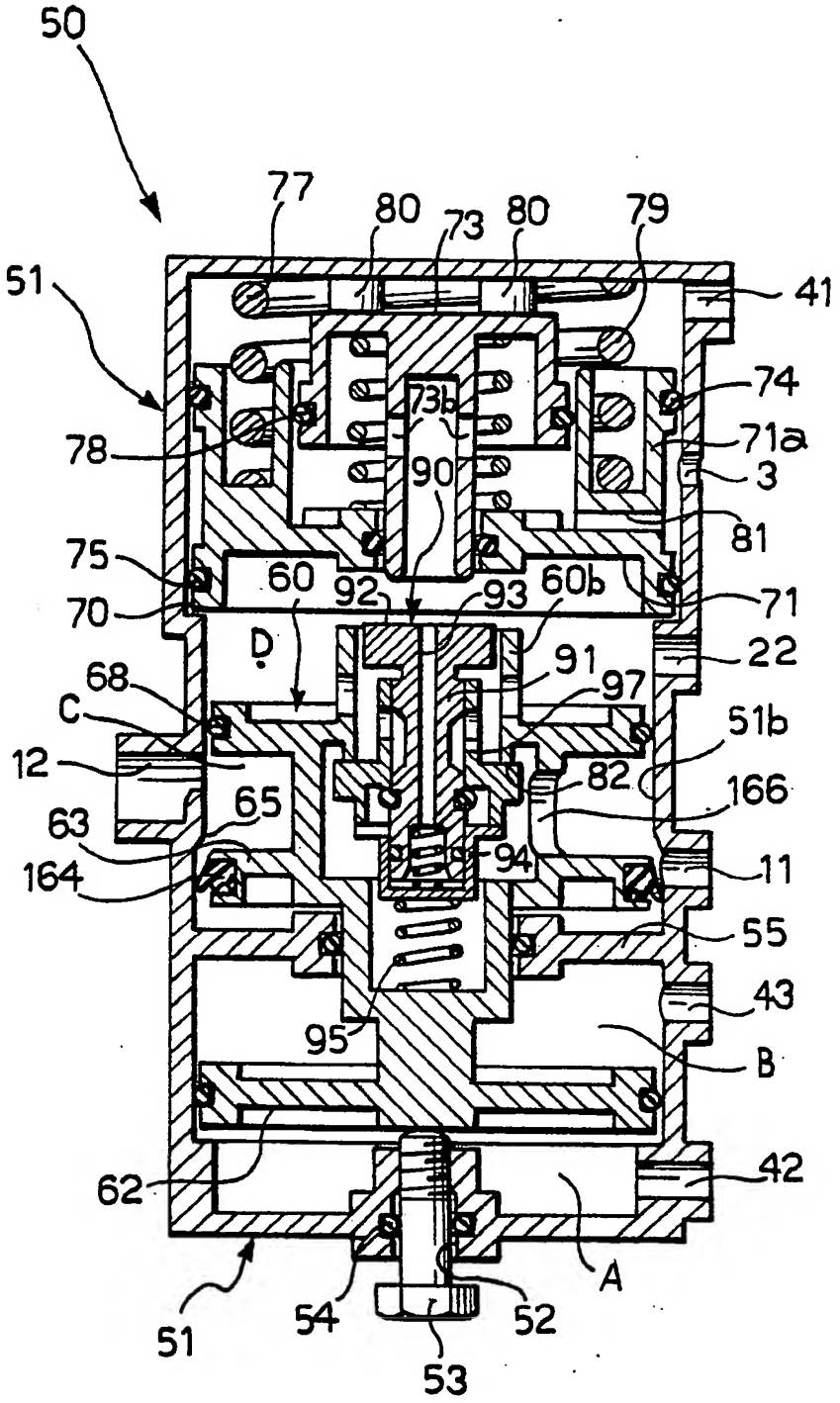

50
77
80
73
80
79
41
F
78
74
71a
3
E
90
81
75
60
73a
92
71
D
93
22
91
C
11
67
82
51b
97
91a
130
120
12
63
66
91b
55
195
43
B
62
42
A
53
51

FIG. 9


50
77
80
73
80
79
41
51
74
73b
71a
78
90
3
81
75
60
92
93
60b
71
70
D
22
91
68
97
C
51b
12
82
166
65
63
94
11
164
55
43
95
B
62
42
A
51
54
52
53